REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
29-04-2005	Final Report	July 2004 to July 2005

4. TITLE AND SUBTITLE
Forecasting Staffing Requirements for a Fluctuating Medical Beneficiary Population.

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Howes, Lori N.

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Baynes-Jones Army Community Hospital
1585 Third Street
Fort Polk, LA 71459

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Department Center and School
Bldg 2841 MCCS-HFB (Army-Baylor Program in Health Care Administration)
3151 Scott Road, Suite 1411
Ft. Sam Houston, Texas 78234-6135

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
34-05

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The purpose of this study was to assess the adequacy of staffing requirements for both the enrolled and non-enrolled patient population located in the Bayne Jones Army Community Hospital catchment area. The existing tool used to determine staffing at military treatment facilities, the Automated Staffing Assessment Model (ASAM) II, was modified to assist in identifying fluctuations in provider requirements based on monthly workload. By using the modified version of ASAM II, it was possible to identify significant monthly fluctuations in provider requirements. Furthermore, this model clearly revealed points where particular clinics either did not have enough or had more than enough providers to meet the number of patient visits for the month.

15. SUBJECT TERMS
Workload, Needs Assessment, Delivery of Health Care, Health Services Accessibility, Regression Analysis, ASAM, Military Health Care System

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON / 19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	66	210-221-6443

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Forecasting Staffing Requirements for a Fluctuating Medical Beneficiary Population

Lori N. Howes

A Graduate Management Project Submitted

to K. Waugh Zucker, M.A., J.D., LlM. in Candidacy

for the

Degree of Master of Health Administration

January 12, 2005

U.S. Army-Baylor University

Graduate Program in Health Care Administration

For my mother, Barbara (1943-2003)

And

Brother, Jimmy (1965-2002)

Acknowledgements

I want to thank to thank the numerous individuals that have assisted and supported my efforts to complete this project. Special thanks are given to those friends and mentors that continued to have faith in my ability to persevere through numerous personal challenges. I will always remember your kindness.

Abstract

The purpose of this study was to assess the adequacy of staffing requirements for both the enrolled and non-enrolled patient population located in the Bayne Jones Army Community Hospital (BJACH) catchment area. The existing tool used to determine staffing at military treatment facilities, the Automated Staffing Assessment Model (ASAM) II, was modified to assist in identifying fluctuations in provider requirements based on monthly workload. By using the modified version of ASAM II, it was possible to identify significant monthly fluctuations in provider requirements. Furthermore, this model clearly revealed points where particular clinics either did not have enough or had more than enough providers to meet the number of patient visits for the month.

A regression analysis, using deseasonalized time series data, confirmed our hypothesis that we can more accurately forecast staffing requirements with the modified ASAM. Ultimately, this will help meet the demands of fluctuating patient workloads.

TABLE OF CONTENTS

List of Tables

List of Figures

Forecasting Staffing Requirements for a Fluctuating Population

Introduction

Conditions Which Prompted the Study

The nation's health care system continues to face significant challenges on a daily basis. Escalating medical care costs, staffing shortages, and difficulties with access and efficiency plague health care administrators as they attempt to ensure high quality patient care while operating within ever-tightening budgetary constraints. With the shortfall in health care funding resulting from implementation of the Defense Health Program Objective Memorandum (POM) 2002-2007, military health care faces many of the same challenges as our national health care system (Sculley, 2001). A unique aspect of the military medical system is that it is responsible for maintaining the medical combat readiness of our active duty members, while also providing health care to an extensive number of military beneficiaries (to include dependents and retirees). In addition, the mission of the military health system continues to expand to support military operations throughout the world.

Although the past decade has been one of the busiest in recent memory (the Gulf War, operations in Bosnia, Kosovo, etc.) for all the military services, the total numerical strength of the Armed Forces as of February 2000 was 1,369,022, a decrease of 1,215 from February of 1999. However, the active Army had increased slightly from 472,228 in 1999 to 474,219 in 2000 (Department of Defense [DoD], 2000).

In addition to a decrease in the overall strength of the Armed Forces, the military health system has downsized to fewer than 100 hospitals and just over 500 clinics world-wide while striving to provide medical care to an eligible beneficiary population (active duty personnel, retirees, and dependents) of 8.2 million (General Accounting Office [GAO], 1999). At a cost of more than $15.6 billion-per-year, care for eligible beneficiaries is provided primarily in military treatment facilities (MTFs), supplemented by networks of contracted, civilian providers (GAO, 1999). The myriad of budget constraints has led to a smaller population of military medical providers attempting to meet the increasing demands of medical beneficiaries. Like all other branches of the Department of Defense (DoD), the Army (and the Army Medical Department (AMEDD)) is forced to do more with less.

In general, most military bases have been affected by the decrease in force structure. Bayne-Jones Army Community Hospital (BJACH), located at Fort Polk, Louisiana, and part of the Great Plains Regional Medical Command, has not been exempt from military cuts in budget and personnel. More specifically, the reduction in force has led to a reduced number of medical providers available to meet the health care needs of the eligible population.

The eligible beneficiary population in the BJACH 40-mile catchment area (a geographic area, determined by the Assistant Secretary of Defense and defined by a set of zip codes, that specifies where certain beneficiaries are required to receive care) is 26,970. Of this total, 7,987 are active duty individuals, according to figures from the Managed Care Forecasting and Analysis System. BJACH has annual hospital admissions of 2,345 patients; annual outpatient visits of 260,093; 58 operating beds; and average bed occupancy of 15 (Office of the Assistant Secretary of Defense for Health Affairs [OASD, HA] 2001).

In addition to the permanent beneficiary population in the BJACH catchment area, there are also individuals temporarily located in the catchment area for training purposes. A large number of these individuals participate

in training rotations at the Joint Readiness Training Center (JRTC). The JRTC conducts 10 training rotations, routinely 3 weeks in duration, each year (See Appendix A for listing of JRTC rotations and dates). These rotations include active and reserve component units from around the United States that come to Fort Polk to simulate deployment to a foreign country and follow-on, combat operations.

Each JRTC rotation consists of a brigade combat team, which includes division-level combat service and combat service support elements. Additionally, each rotation includes a tailored, corps-level task force of logistical and medical units, as well as heavy United States Air Force participation once the scenario progresses into air-land operations. Units that train at the JRTC are various components of the light infantry, to include airborne, air assault, ground, and special operations forces, of both active and reserve components. Each unit has different medical risks inherent in its prescribed missions.

Combat support units include military police, signal, and engineer units. The major combat service support element is the forward support battalion, which is comprised of quartermaster, maintenance, transportation, and medical companies. The corps level medical elements include a

command and control element; a combat support hospital; and elements of corps medical logistics, preventive medicine, dentistry, and air and ground evacuation units (M. Hall, personal communication, November 20, 2000).

In addition to the readiness training gained from JRTC participation, there also is a tremendous amount of "real world" health care generated during the rotation. This is one of the unique characteristics of the JRTC. Most rotations have a corps-level deployable hospital, normally consisting of a level III (i.e., tertiary care) combat support hospital or field hospital, although on occasion an area support medical battalion may provide medical support on a more limited basis.

The JRTC provides a unique training opportunity for hospital commanders in deployable units in that it allows them to practice most of their wartime requirements. These requirements range from deployment, to establishment of a hospital in a combat theater, to full provision of health care, to command and control. Maximum use of the Multiple Integrated Laser Engagement System (i.e., simulated casualties generated by the brigade combat team's combat operation) creates patients for training purposes.

Additionally, the rotational hospital simultaneously

receives and treats a selective range of actual patients who have sustained real injuries and illnesses during training. Successful treatment of actual patients at the JRTC site reduces the number of patients who require transportation out of the field environment to BJACH. Once a JRTC patient is evacuated to BJACH, that patient may delay the care of other eligible beneficiaries or cause their care to shift to a network provider.

During a typical JRTC rotation, the level III medical unit receives, treats, and returns to duty approximately 190 actual patients. In addition to the level III hospital at the JRTC site, a troop medical clinic, a separate fixed facility, operates during all JRTC rotations. It is the responsibility of the rotating unit to staff the troop medical clinic. As soon as any rotational soldiers arrive at Fort Polk, the rotational brigade opens and operates Troop Medical Clinic #4. This clinic is located on North Fort (Fort Polk is split into the North Fort and the South Fort) and is intended to provide the portal to health care for rotational soldiers. Staff use the Composite Health Care System (to identify and account for the number and type of patients), and the facility has limited medical holding capability. The providers at Troop Medical Clinic #4 can

send patients to BJACH for outpatient care or evacuate any patient to the BJACH emergency room for care that exceeds their capability (M. Hall, personal communication, November 20, 2000).

Capturing the workload of JRTC has been a challenge for health care administrators because BJACH does not have an adequate method to determine what the additional workload will be when a rotational unit does not bring a level III hospital. Although one might assume this could be estimated by looking at the workload of the level III hospitals that do accompany units, this is not the case. Personnel of rotational, level III hospitals do not enter patients into CHCS; and the logs that they keep often do not include enough clinical detail to be helpful in determining acuity levels.

Statement of the Problem

Reductions in force, increased deployments, and a changing beneficiary population have caused increased difficulty in meeting the medical mission of treating soldiers, family members, and retirees within the military health system. Medical providers are expected to treat patients at their assigned medical facility, be readily available to back-fill other MTFs, conduct Professional

Officer Filler System missions, and perform various other contingency operations. These additional requirements often leave the MTFs short of the required number of providers needed to meet the medical mission. When this occurs, waiting times may increase and patient satisfaction may decrease.

Ensuring adequate staffing is particularly difficult in MTFs that have a fluctuating beneficiary population. Whether the fluctuation is the result of transfers by active duty members, seasonal moves by retirees, or deployments of troops for training purposes, it remains a continuous challenge to predict workload requirements and ensure appropriate staffing in an environment in which the size of the eligible population fluctuates.

Literature Review

Access to health care is viewed as one of Kissick's three facets (cost, quality, and access) of health care service delivery (Woods, 1999). Many studies have focused on both cost and quality of care. However, it has only been in the past few years that access to health care has come to the forefront of the nation's health care concerns. Perhaps the best example of lack of accessibility is seen by the limited access provided to the estimated 40 million

uninsured or underinsured Americans (Sultz & Young, 1999).

In the military health care system, lack of access is not related to lack of insurance; rather, it may be related to the non-availability of, or delay in seeing, the appropriate provider. Throughout the past decade, the military health system has attempted to improve access to health care despite the numerous challenges mentioned previously (i.e., increased military operations and decreased funding). According to the annual Health Care Survey of DoD Beneficiaries (HCSDB), the percentage of all enrollees that were satisfied with their access to care in 1998 was 74% (percent of respondents who indicated an 8, 9, or 10 on a 10-point scale) compared to 63% prior to the implementation of TRICARE (HCSDB, 1999).

TRICARE was developed in response to large cost overruns in the military health care system in the late 1970s and 1980s. Overall costs for military health care, including the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), the predecessor to TRICARE, began to rise at a much higher rate than the private sector (Chapman, 1995). The General Accounting Office (GAO) report, "Defense Health Care Issues and Challenges Confronting Military Medicine," stated that the cost of

military health care rose 225% in during the 1980s, as compared to 166% for the nation as a whole. "During this period, the medical portion of the defense budget doubled, from 3 percent of the total to 6 percent" (GAO, 1995).

In addition, due to a growing pool of patients, access to the military health care system became increasing difficult for dependents and retirees (Chapman, 1995). In order to increase patient access to care, TRICARE was designed as a triple-option benefit program affording beneficiaries a choice between a health maintenance organization, a preferred provider option, and a fee-for-service option. TRICARE Prime, the health maintenance organization option, is the only option into which members must enroll and is devoid of co-payments as long as the patient is seen at an MTF or by a network provider. TRICARE Extra, the preferred provider option, and TRICARE Standard, the fee-for-service option, remain identical in structure to the previous CHAMPUS program. Regional managed care support contractors in 11 health care regions help administer the program (GAO, 1998).

TRICARE was implemented over 8 years and phased in one or two regions at a time. In the regions where TRICARE has been in place for 3 or more years, satisfaction with access

to care improved to 83% in 1998 from 70% average prior to TRICARE implementation. This is higher than recent civilian care data, which showed that 79% of beneficiaries were satisfied with access to care (HCSDB, 1999). However, results of the DoD Customer Satisfaction Survey (fiscal year 2001) show scores for overall satisfaction with TRICARE have remained consistently high since 1997 (TRICARE, 2002).

The DOD faced many of the same challenges in the delivery of health care to its beneficiaries as were experienced within the general population in the United States. Those challenges include managing the increasing costs of providing medical care, as well as providing equal access to such care (GAO, 1999). Improving access to care was one of the main reasons for the implementation of TRICARE (GAO, 1999); however, one of the most common concerns about TRICARE is that access standards (30 days for a wellness or specialty care appointment; 7 days for a routine appointment, and 24 hours for an acute care appointment) are not always met.

In general, access to health care has been found to significantly affect overall patient satisfaction more than the quality of care received (Rutledge & Nacimento, 1996). In past years, the United States government has made efforts

to improve access to health care. The tools to do so are available (i.e. - provider appointment templates; open access initiatives, in which 50% of a provider's patients will be seen the same day they call for an appointment); however, dramatic cuts in medical personnel and facilities have led to difficulties in meeting the needs of the current military population as well as family members and retirees. This has been especially challenging when attempting to meet the needs of retirees, to include those over the age of 65.

Prior to 1996, retirees and their families competed with active duty members and their families for care at MTFs. With the reductions in budgets, staffing, and facilities experienced in the 1990s, retirees received care on a space available basis. These changes in availability of health care were interpreted as a continual erosion of benefits for retirees, especially those over the age of 65. Some retirees have felt "cheated" in the past by what may have been perceived as broken promises made by the United States government; assuring them lifetime medical care after years of dedicated service to this country(Military Health Care Reclamation Group, 2003). This unlimited access within MTFs for retirees over 65 can also add to difficulties in maintaining medical readiness for active duty members and

maintaining readiness capability for military operations. Additionally, as of 2001, retirees over the age 65 are eligible for Medicare with TRICARE as a second payer. Despite this fact, many of the over 65 retirees prefer to be seen at the MTFs. In many cases, the retirees are more familiar and comfortable with the operations of the military health care system. Fortunately, since the initiation of the TRICARE for Life program in 2001, seniors now have access to expanded medical coverage if they are uniformed service beneficiaries 65 or older, are Medicare eligible, and have purchased Medicare Part B (TRICARE, 2003).

Although access to health care continues to improve, there continues to be a delicate balance between caring for those soldiers currently on active duty, their family members, and the retiree population. In addition, many MTFs must take responsibility for the healthcare of individuals that are not enrolled to their MTF. This includes active duty members that are temporarily assigned to a post for training purposes such as JRTC.

As stated previously, approximately 10 training rotations, each consisting of 3,500-5,000 soldiers, occur annually at the JRTC. Demanding and realistic combat operations take place during 10 to 12 days of each rotation.

Training is intense and tactical, nighttime maneuvers are frequent. Consequently, the incidence of training injuries (i.e., sprains, broken bones, cuts, and contusions), and medical disorders related to allergic reactions, extreme temperature, and insect stings are not uncommon (M. Hall, personal communication, November 2000).

The first, and preferred, option for the treatment of these less severe and non-life threatening cases rests with the rotational unit's medical elements. However, at times, required medical care cannot or should not be provided by the rotational unit. This may be due to either the unavailability of a level III hospital to support a particular rotation or the fact that an injury or illness requires definitive care beyond that which risk management guidelines authorize treatment in a field environment. The question then becomes, "Can BJACH absorb the additional workload of the rotational unit and continue to provide access to the permanent party soldiers, their family members, and other eligible beneficiaries in the Fort Polk area?" Additionally, from the perspective of a regional medical commander, the question arises as to whether the facility is sufficiently staffed to meet the health care needs of both the permanent party and rotational unit

populations. If so, are there overages in staffing that could be more effectively utilized in another facility within the region? (G. Taplin, personal communication, August 14, 2000).

Currently, the Department of the Army policy for the development of Table of Distribution and Allowance staffing practices is contained in Army Regulation 570-4 (Manpower Management) and Army Regulation 570-5 (Manpower Staffing Standards Systems). The current standard for determining manpower requirements within the U.S. Army Medical Command (MEDCOM) is the Automated Staffing Assessment Model (ASAM). The Manpower Requirements Branch of the MEDCOM is responsible for the management of the ASAM (Reiser, 1997).

This staffing model was originally designed in response to a Congressional mandate to "use the least costly form of manpower consistent with military requirements and other needs of the DOD" as stated in Title 5 U.S.C. §502 (88 Stat 399) Public Law 93-365. In addition, DoD Directive 1100.4-1, Guidance for Manpower Programs, states, "Each service shall undertake only such programs as are actually essential, and shall program manpower requirements at the minimum necessary to achieve specific vital objectives" (MEDCOM, 1999).

The ASAM is a mathematical model used to determine minimum, essential medical manpower requirements for each of the MTFs under MEDCOM's purview. The ASAM II, which is currently fielded to all Army MTFs, is the second-generation model that defines minimum manpower requirements by business functional (medical & non-medical) type, and personnel type (provider & support staff) (MEDCOM, 1999).

According to information provided by the Manpower Division of MEDCOM, the ASAM II can project future requirements; be site specific by defining mission unique requirements; quantify readiness requirements; provide the MTF administrator key resource indicators; be easily tailored to keep pace with current health care trends; and is available in an Excel™ spreadsheet format (MEDCOM, 1999). Although the tool does assist the MTF administrator with essential resource indicators, it only identifies minimum manpower requirements based on an aggregate 12-month score. It does not account for fluctuations in, or unique characteristics of, the population served throughout the year. Therefore, it does not adequately determine staffing requirements for those facilities that have a significant fluctuation in beneficiary population such as BJACH.

Due to the inherent nature of medical care, predicting

staffing levels for providers is a complicated task. It is possible to make predictions of expected workload by evaluating historical data if the population base is stable; however, it is almost impossible to plan for major fluctuations in workload caused by changes in the non-permanent party (non-enrolled) population. In the civilian sector, this issue is analogous to changes in population due to migrant workers, "snow birds", or students in towns where colleges and universities exist (Rust, 1990).

It is the author's premise that staffing requirements can be calculated with more accuracy using a modified version of the ASAM during periods of workload variation. This modified version, developed jointly by Mr. John Reiser of The United States Army Medical Command, Manpower Requirements Branch, and the author, uses essentially the same method to determine staffing requirements, as does the existing program. The major difference is that the modified version breaks down the workload on a monthly basis instead of using a 12-month average. This will enable the planner to predict more accurately when fluctuations in workload will occur and, thus, will ensure a more effective level of staffing coverage throughout the year. For purposes of this study, the modified version of ASAM would allow the

commander of the Great Plains Regional Medical Command the ability to plan for augmentation staff throughout the year, thus using limited resources more effectively.

Purpose

The focus of this project is to analyze the adequacy of provider staffing levels at BJACH and determine if staffing is adequate for both permanent party enrollees to BJACH and the temporary duty, non-enrollees (i.e., JRTC rotational personnel) seen at BJACH. If it is determined that the baseline provider staffing levels at BJACH are adequate to meet the health care needs of the population organic to Fort Polk, the next step is to explore the hypothesis that staffing levels can be more effectively predicted based on historical workload when broken down by monthly instead of yearly workload totals. The pre-study annualized figures often disguise predictable "spikes" based on seasonal and supported population variables. In addition (although not examined in the current study), these periodic surges by patient type may be more effectively managed by augmentation of selected providers based on identified variables (i.e., the type of combat unit training at the JRTC in each rotation).

There are many advantages to pre-determining peak

periods that will require additional provider staffing. Doing so may reduce inadequate staff ratios, workload and facilitate more efficient utilization of an increasingly limited number of Army physicians practicing within the military health system. Additionally, it may allow the military to better utilize both borrowed manpower and reserve component providers intermittently available throughout the year. A predictive method of determining staffing requirements would not only aid the MTF Commander in supporting sites with major training rotations (i.e., Fort Polk-JRTC, Fort Irwin-National Training Center, basic training sites, etc.), but also in meeting the overall goals of maintaining excellent quality, improving access, and reducing costs at all MTFs.

Methods and Procedures

Persons, Objects, or Events

This study focused on the number of visits for identified outpatient clinics within BJACH for 30-months, October of 1998 through March of 2001. Data for this study were extracted utilizing the All-Region Server Bridge. This bridge is the portal to a set of military health system data files: (summary files, personnel files, and health care service files) and is incorporated into the Executive

Information/Decision Support central database.

The central database is a product of the Executive Information/Decision Support Program Office, developed in conjunction with the Management Activity Health Program, Analysis, and Evaluation Branch. This database includes a Managed Care Forecasting and Analysis System and consolidates data from multiple sources within the military health system. This application allows the user to view data from a corporate perspective in order to support decision-making processes. Data for this study were retrieved from the Standard Ambulatory Data Record, Health Care Standard Record, Defense Eligibility and Enrollment Reporting System, and Medical Expense and Performance Reporting System (MEPRS) Executive Query System.

Specifically, the BJACH workload data for this study were extracted for 3 fiscal years (1999-2001) from the Standard Ambulatory Data Record database to obtain the number of visits by Defense Medical Information System Identification Number (DMIS) and beneficiary category. Each outpatient service (clinic) was identified by the designated MEPRS code (i.e., the code BIA identifies the emergency medicine clinic). The MEPRS codes used for each of the four outpatient clinics used in this study are as follows, BIA =

emergency medicine, BEA = orthopedics, BAA = internal medicine, and BGA = family practice.

To determine which of the BJACH clinics may have been most affected by additional workload from the JRTC rotations, workload data were collected from the fiscal year 1999-2001 Standard Ambulatory Data Record database and compared to the JRTC rotation dates. Specific unit types were identified, as were the types of organic medical assets available during each rotation. This was important in determining which clinics were likely to receive patients from JRTC rotations (i.e., one possible assumption for further study is that more soldiers from airborne units would require treatment from the emergency room and orthopedic clinic, than would soldiers from other combat units training at JRTC).

Table 1

Outpatient Visits by Clinic

Clinic	1999	2000	2001*
Orthopedics	4,659	4,711	2,076
Internal Medicine	16,290	16,008	8,241
Emergency Medicine	24,973	25,725	11,439
Family Practice	81,465	86,406	36,668

* 6 months of data

Note. Table 1 represents outpatient visits for the four departments used in this study for fiscal years 1999-2001.

In order to capture the number of patients seen at BJACH from the JRTC rotations, the data were then broken down by parent Defense Medical Information System identification number codes. These codes identify the facility in which the individual is enrolled. Data were then separated by clinic and by month, yielding the number of visits for each Defense Medical Information System identification number code by clinic and month.

Operational Definitions

It is expected that the dependent variable will be affected by the manipulation of the independent variable (Cooper & Schindler, 2000). The dependent variable (Y) for this study is the number of required providers for the

identified outpatient clinics used in the study sample. The term "provider" includes physicians, physician assistants, practical nurses and their equivalents. Clinics include emergency medicine, family practice, internal medicine, and orthopedics. The alphabetic code following each clinic represents the MEPRS code for that clinic.

The independent variable refers to the variable that is expected to have an influence on or explain variations in the dependent variable (Sanders, 1995). The independent variable (X) in this study refers to the number of visits generated for each of the four outpatient clinics in the study sample.

Hypotheses Tested

When evaluating the workload (outpatient visits) to provider ratios, ASAM projects the minimum essential staffing requirements to meet the annualized workload totals for each of the four clinics. However, based on the modified version of the ASAM model (see Table 2), BJACH may not have adequate provider staffing to meet the needs of its beneficiary population during identified peak months. In addition, there appears to be a relationship between workload increases during specific calendar months and the presence of JRTC rotations.

The null hypothesis states that there is no difference between the sample estimate and the population parameter to which it is compared (Cooper & Schindler, 2000). For this study, the null hypothesis is that staffing is sufficient at BJACH regardless of fluctuations in beneficiary population during training rotations (no differences in visits per month). The null hypothesis would be rejected if there were insufficient staffing during the mentioned periods (significant differences in visits per month). Additional variables to consider for future study include the presence of organic medical assets and the type of unit that is training during JRTC rotation.

Validity and Reliability

According to Babbie, 1986, validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. More specifically, criterion-related validity, sometimes called predictive validity, is based on some external criterion such as the variables described as seasonal periods, presence of additional medical assets, and type of unit that is training during JRTC rotations identified above. For example, "Will we really be able to forecast staffing needs accurately?" Reliability is that quality of a measurement

method that suggests that the same data would have been collected each time in repeated observations of the same phenomenon (Babbie, 1986). If the measure is not reliable, it cannot be valid (Cooper & Schindler, 2000). In this study, the modified version of ASAM was tested with four separate outpatient clinics.

A one-way analysis of variance (ANOVA) was then conducted to determine if there was a significant difference in providers required per month based on the fluctuation of patient visits. The effect of month was not significant, $F(5,18) = .048$ $p=.98$, indicating that more data and further analyses are needed to determine if the modified ASAM model is more accurate than the original ASAM model as a predictive measure of provider staffing requirements.

Ethical Considerations

The most obvious concern in the protection of research subjects' interests and well-being is the protection of their identity (Babbie, 1986). In this study, no patient specific information was utilized in preparing the results; therefore, there are no issues of confidentiality. Data are identified by beneficiary code (active duty, dependent of active duty, etc.) and by DMIS (codes that identify at which medical facility an individual is enrolled), but no social

security numbers, or other individualized identifiers were used.

Statistical Method

Trend analysis using linear regression seasonally adjusted with time series data was used in this study to show how the ASAM model can be modified to forecast future provider requirements resulting from fluctuations in workload. When using time series data, it is assumed that there is an irregular component in the time series that accounts for the random effects that cannot be explained by the trend and seasonal components. The following multiplicative model was used in this study to describe the actual time series value (Y_t).

$$\underline{Y_t = T_t \times S_t \times I_t}$$

In this model, Y_t is the predicted value, T_t is the trend measured in units of the item being forecast (patient visits), the S_t is the seasonal index, and I_t is the irregular component. It is important to deseasonalize the time series if a seasonal influence is present. Comparisons by period are meaningless unless this factor is removed. By dividing each observation by its corresponding seasonal index, the effect of the season is removed from the time

series. Once the data are deseasonalized, the time series can be used to identify a linear trend. The following model was used to identify the trend.

$$T_t = b_0 + b_1 t$$

In this model, b_0 is the intercept of the trend line and b_1 is the slope of the trend line. Therefore, the subscript t corresponds to the month of visits (t=1 is the first month of visits, t=16 is the sixteenth month of visits).

To illustrate on a small scale how the modified ASAM can be useful for predicting staffing requirements, data were utilized from four clinics at BJACH during the first 6 months of FY 2001 and entered into a modified version of the ASAM (see Table 2). The modified ASAM automatically calculates the number of providers required per month to meet the medical requirements of the patient population based on monthly workload figures.

Table 2

Modified ASAM Example of the Four Clinics Used in Study

A	C	D	E	F	G	H	I	J
Medical Planning Factor (MPF) Yield	Function		2000 OCT	2000 NOV	2000 DEC	2001 JAN	2001 FEB	2001 MAR
19	Family Practice	Workload	*5,813*	*6,501*	*5,062*	*7,332*	*5,952*	*6,008*
	MPF = 0.360	Provider	14.43	16.14	12.56	18.20	14.78	14.92
4	Internal Med	Workload	*1,368*	*1,434*	*1,135*	*1,492*	*1,303*	*1,509*
	MPF = 0.433	Provider	4.09	3.56	2.82	3.70	3.24	3.75
3	Orthopedics	Workload	*395*	*407*	*328*	*390*	*366*	*190*
	MPF = 0.525	Provider	1.43	1.47	1.19	1.41	1.33	0.69
8	Emergency	Workload	*1,804*	*1,965*	*2,212*	*2,461*	*2,018*	*979*
	MPF = 0.500	Provider	6.22	6.78	7.63	8.49	6.96	3.38

Note. Column A represents the medical planning factor (MPF) provider yield for each clinic as determined by the unmodified ASAM (MEDCOM, 1997). The provider yield reflects the total number of providers earned based solely on workload. This provider yield is determined by multiplying the workload (italicized number in columns E-J) by the MPF (column C) and then dividing the answer by 145, the number of hours equaling a "full time requirement" for a one-month period (MEDCOM, 1997).

Each clinic has a medical planning factor (column C), which represents the estimated factor that is used for each unit of workload in the work center. For instance, in the outpatient or "B" accounts, the medical planning factor contains time for the provider to see the patient coupled with relative values for surgery, procedures, ward rounds, as well as all military and administrative essential functions.

Using the emergency medicine clinic (bottom two rows of Table 2) as an example, data from the month of October 2000 (column E) show that there were 1,804 visits to the emergency medicine clinic. The modified ASAM model calculates provider requirements for the month of October as 6.22.

This modified version of ASAM shown in Table 2 uses the same method as the unmodified ASAM to calculate provider requirements. The difference is that the modified version is based on workload adjusted for monthly fluctuations instead of an annualized total of workload (visits). When staffing requirements are calculated, using monthly workload rather than an annualized total workload number, the model more accurately reflects the fluctuation in provider requirements each month. The medical planning factor

(unmodified ASAM) annual provider yield (column A) for the emergency medicine clinic is eight providers.

By utilizing the modified ASAM results shown in Table 3(column D) to predict provider requirements by month, it can be seen that most months require fewer than eight providers (i.e., March 2001) and only one requires more than eight, (i.e., January 2001).

Table 3

Example of Emergency Room Providers Comparison for FY 01

A Months	B Visits	C Required	D Modified	E Actual
Oct-00	1,804	9	7	10
Nov-00	1,965	9	7	8
Dec-00	2,212	9	8	7
1-Jan	2,461	9	9	9
1-Feb	2,018	9	7	7
1-Mar	979	9	4	5

Note. Table 3 is a summary of providers required and utilized in the emergency medicine clinic during the first 6 months of FY 2001. All full time equivalent (FTE) requirements were rounded up (if above .5) to reflect a whole number of providers. Column B lists the actual

workload (visits) for each month. Column C lists the ASAM determined requirement (based on annual visits). Column D depicts the ASAM requirements based on the modified version of ASAM; and column E lists the actual numbers of FTE providers working in emergency medicine clinic for FY 2001.

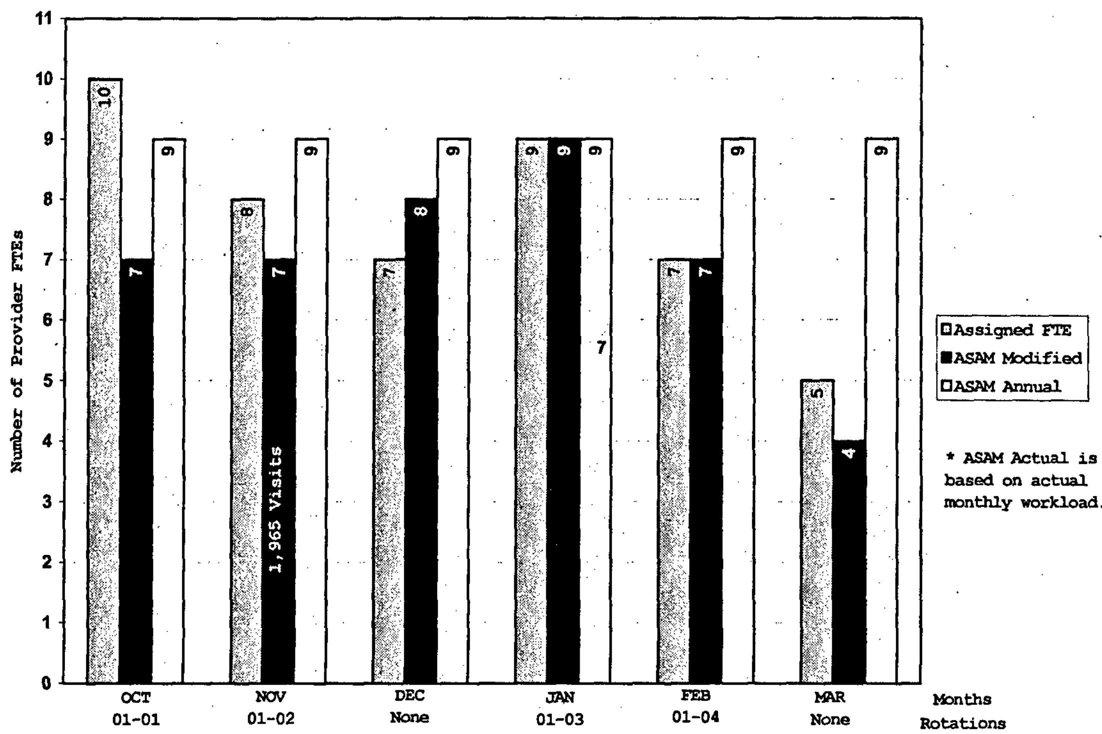


Figure 1. This chart reflects the comparison of ASAM projected providers to ASAM modified projected providers to actual provider FTEs at the emergency medicine clinic for the first 6 months of FY 2001.

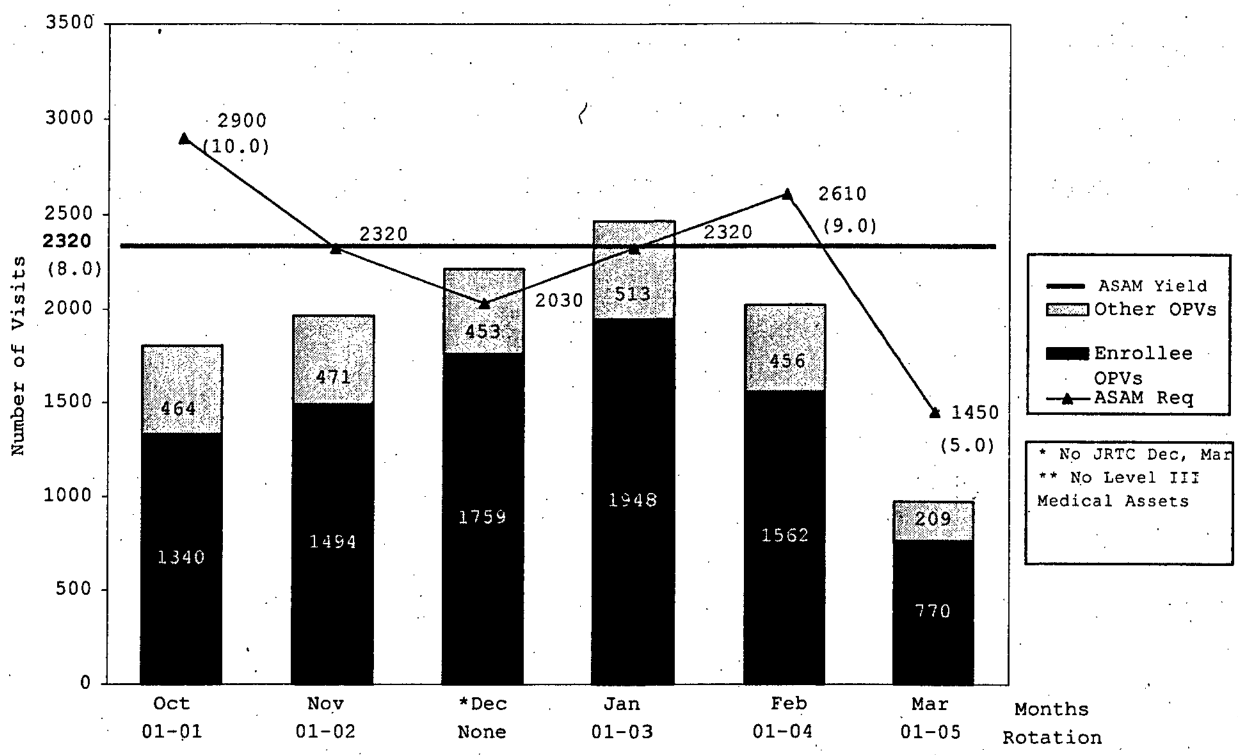


Figure 2. This chart represents the comparison by month of outpatient visits by BJACH enrollees to all other outpatient visits (non-BJACH enrollees) for the emergency medicine clinic. The lower portion of each column shows the outpatient visits of BJACH enrollees. The upper portion of each column shows outpatient visits of non-BJACH enrollees. The thick line across the top is the total number of providers required per month for emergency medicine based on the ASAM II calculation (eight provider FTEs which is equivalent to 2,320 visits). The jagged line with triangles

represents the number of providers that would be required based on the modified ASAM model for the designated month.

JRTC rotations (01-01 through 01-05) are labeled across the bottom of the chart. Actual dates for the rotations are listed in Appendix A. During the months of January and March 2001, level III medical care was not available at the JRTC site. Rotations are listed to show the relationship between high and low monthly visits with the presence of JRTC. Based on data collected for this particular study, the presence of organic medical assets could not be used as a predictor of additional patients seen at BJACH during JRTC rotations.

As stated previously, there are various methods of assessing and forecasting or predicting staffing requirements available. To further validate the ASAM model, a deseasonalized model of forecasting was used (Table 4).

Planning is one of the most essential aspects of managing an organization. When determining staffing requirements, it is important to review historical data to evaluate the possibility of trends. Determining if there are any types of trends or fluctuations in staffing patterns will assist the manager in adjusting for future staffing requirements. Historical data form a time series which is a

"set of observations of a variable measured at successive points in time or over successive periods of time" (Anderson, Sweeney, and Williams, 1997). While measurements in a time series may be taken every hour, day, week, month or quarter, they were taken monthly to forecast workload and staffing requirements in this study.

A review of the historical workload from BJACH Fiscal years 1999-2001 demonstrated visible trends. According to the MEPRS data available for BJACH, there are increases and decreases in patient visits from month to month. Variability in monthly visits can be great depending upon the clinic studied. For instance, for the period referenced, the family practice clinic showed a low of 5,885 visits for the month of December 1998 and a high of 8,325 visits for the month of March 1999. In addition, some months and clinics appear to show a relationship to the presence of JRTC rotational units, as noted in November 2000 in the orthopedic clinic. That particular month, an airborne unit was conducting training at JRTC. This type of unit would tend to have more orthopedic type injuries from parachute operations than a non-airborne unit.

When historical data are available (as they are in this case), quantitative forecasting methods can be used. When

there is a reasonable assumption that the pattern of the past will continue into the future, a forecast can be developed using a time series method (Anderson, Sweeney, and Williams, 1997).

Table 4

Forecast Model Example of BJACH Emergency Medicine Visits

A	B	C	D	E	F	G
Fiscal Year	**Month**	**Count of Month**	**Outpatient Visits by Month**	**12 Month Moving Average**	**Centered Moving Average**	**Seasonal-Irregular Component**
FY99	1	1	1917			
	2	2	1959			
	3	3	2037			
	4	4	2163			
	5	5	2328			
	6	6	2448			
				2,081.08		
	7	7	1923		2,088.54	0.9207
				2,096.00		
	8	8	2182		2,102.85	1.0376
				2,109.70		
	9	9	2040		2,113.74	0.9651
				2,117.78		
	10	10	1835		2,114.95	0.8676
				2,112.13		
	11	11	1926		2,096.71	0.9186
				2,081.29		
	12	12	2215		2,050.73	1.0801
				2,020.17		

In the example provided in Table 4, the time series analysis is represented as a monthly measurement. In this example, similar to the ASAM example from Table 2, the numbers of visits are listed for the emergency medicine clinic in column D. The month of the fiscal year (October-September) is listed in column B (Month 1 is October; month 2 is November, etc.).

Random fluctuations are an element of time series analysis. However, the gradual shifting of a time series is known as the trend in the time series (Anderson, Sweeney, and Williams, 1997). This type of trend is normally a result of long-term factors such as changes to population demographics, changes in the size of population, technology, and in consumer preferences (Anderson, Sweeney, and Williams, 1997).

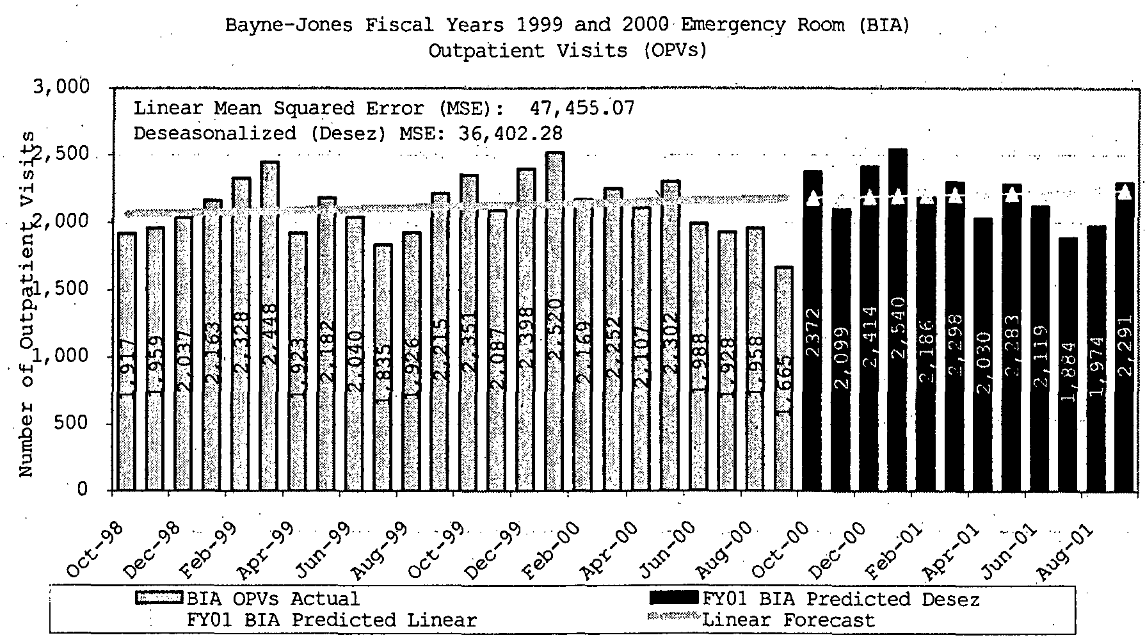


Figure 3

In this study, the variables related to JRTC rotations may account for the changes in the time series. All four clinics (similar to Figure 3) show a month-to-month variation in the number of patient visits. In addition, there is a linear increase in the number of visits per month.

In addition to a trend component of a time series, seasonal and irregular components may exist. Time series often show sequences of points above and below the trend line. Typically, future values of the time series do not fall exactly on the trend line. Recurring sequence points above and below the trend line, lasting over an extended

period, may be attributed to cyclical components of the time series (Anderson, Sweeney, and Williams, 1997).

When a time series shows a regular pattern over an extended period (for example a higher number of visits in the family practice clinic during the month of January each year), this pattern may be attributed to a seasonal component. Once deviations of the time series are accounted for through trend, cyclical, and seasonal components, the residual variations caused by short-term, unanticipated, and nonrecurring factors are called the irregular component (Anderson, Sweeney, and Williams, 1997).

This study uses a deseasonalized model to forecast the values of a time series that has both trend and seasonal components. Removing the seasonal effect from a time series is known as deseasonalizing the time series. After this process is complete, it is easier to identify period-to-period comparisons to see if a trend exists (Anderson, Sweeney, and Williams, 1997).

The first step taken in this process was to compute seasonal indices and use them to deseasonalize the outpatient clinic visit data from BJACH. A regression analysis was then completed on the deseasonalized data to estimate the trend. The computational procedure used to

identify each month's seasonal influence begins by computing a moving average to isolate the combined seasonal and irregular components, S_t and I_t (see Table 4, column F).

Results

The results of this study demonstrate that BJACH does have an adequate amount of baseline provider staff based on the current staffing projections by the ASAM II Model. However, due to the fluctuation in the medical beneficiary population at Fort Polk, a more accurate staffing level, by work center and by month, could be effectively predicted based on historical workload and demographic variables utilizing a modified version of the ASAM model. As stated previously, the current annualized figures disguise predictable "spikes" based on seasonal and supported population variables.

In addition, this study demonstrates that the ASAM can be modified for use in more accurately forecasting provider staffing requirements on a monthly basis; thus, effectively meeting the provider requirements for a fluctuating medical beneficiary population.

As stated previously, there is a seasonal component to the data (Table 4). This component may be due to the presence of JRTC training cycles. To remove these effects,

the time series was deseasonalized. As seasonality follows a regular pattern, the conclusions of one year may hold for the others as well. By dividing each time series observation by its corresponding seasonal index, the effect of the season was removed from the time series (Appendix B).

Once the data were deseasonalized, a regression line was fit to the data to determine the linear trend and the adequacy of the model (Appendix C). The standard error for the deseasonalized model was smaller than the standard error prior to deseasonalizing the date, indicating that the model better fits the data. Following this, simple linear regression was used to predict future workload (Appendix D).

Emergency Medicine

As an example, for the emergency medicine clinic (MEPRS code BIA), the slope of 5.108 indicates that over the past 24 months, the clinic has experienced, on average, a slight increase in workload per month. Using the trend component only, we would forecast workload of 2,181 visits for month 25 (the first month in which workload is forecasted).

However, this number does not take into account the seasonal index. By multiplying forecasted workload of 2,181 by the adjusted seasonal index of 1.0879 (Appendix D), the projected workload for month 25 is approximately 2,372. The

identical method is used for the next 11 months of the year to predict the workload for emergency medicine in 2001. Appendix E graphically depicts this projection.

Internal Medicine

A similar methodology was used for the internal medicine clinic. The positive slope of 3.058 indicates that it also experienced an increase of visits per month over the past two years. Using the trend and seasonal indices, the projected workload for month 25 is 1,352 visits. The projected workload for the next 11 months is shown in Appendix F.

Orthopedics

Following the same trend as the emergency medicine and internal medicine clinics, the orthopedic clinic experienced a slight increase in workload over the past 2 years. For month 25, using the trend and seasonal indexes, the projected workload is approximately 413 visits. The projections for the next 11 months are shown in Appendix G.

Family Practice

The final clinic examined was family practice. The slope of 31 again indicates an increase in visits over the past 2 years. On average, the family practice clinic experienced an increase of over 31 visits per month. For

month 25, the projected workload is approximately 7,384 visits. This projection and those of the next 11 months are shown in Appendix H.

Discussion

The objective of this project was to evaluate the current staffing level at BJACH to determine if there is a need to adjust staffing levels based on the monthly fluctuation of visits. Although several variables (seasonality, medical asset availability, and type of unit) could be related to monthly fluctuations in visits at BJACH, seasonality is the only variable tested during this study. Although fluctuations exhibited through seasonality can be related to the increases and decreases of populations resulting from JRTC rotations, it may also be the result of normal seasonal affects (i.e., flu season, holiday periods etc.).

As hypothesized, the results show that while the current ASAM model is useful in determining baseline-staffing requirements, the modified ASAM more accurately predicts staffing requirements based on a fluctuating beneficiary population. This model was further validated through time series and regression analyses, in which it was determined that once the monthly staffing requirements are identified

through the modified ASAM model, adjusting for seasonal components might more reliably predict staffing requirements.

Conclusions and Recommendations

This study identified a significant monthly fluctuation in provider requirements when using the modified version of ASAM. Furthermore, this model clearly revealed points where particular clinics either did not have a sufficient amount of providers or they had more than was needed to meet the number of patient visits for that month.

In addition, when comparing fluctuations in visits to the dates in which JRTC rotations occurred, relationships between JRTC variables (seasons, additional medical assets, type of unit) are evident.

Finally, to validate this model, regression analysis with time series data was used to forecast future requirements from workload data. When using regression analysis, trends such as increases and decreases in workload over the year could be determined for the four clinics used in this study. Additionally, it was possible to determine the seasonal variation, such as the presence of JRTC rotations, and predict monthly workload accordingly.

In this model, time was used as the independent

variable. One can imagine, however, as discussed previously in this paper, there are many variables, both demographic and economic, that could be used in a regression analysis. If the values of such variables as funding, medical assets, and building additions are known, these additional independent variables could be considered for developing a forecasting model. The determination of other sets of predictor variables is suggested as an area of future research.

This model calculates the total number of providers needed for BJACH. From this result, the number of providers needed to be contracted can be determined by subtracting the available military provider pool. By determining the monthly patient demand using a population supported demand model that considers such variables as a past demand history, seasonal and specific weekday fluctuations, patient no show-rates for each clinic, access to care can be managed more effectively. This will ensure coordination of predetermined intervention measures, such as borrowed manpower as well as utilization of reserve component providers ensuring in advance that the facility has the required amount of provider staff on a monthly or weekly basis opposed to an annualized number of workload (visits), BJACH can more

accurately project provider requirements for its fluctuating patient workload. In addition, the facility can reduce the cost of temporary staff; better utilize borrowed manpower as well as reserve component soldiers as provider assets. This would help reduce costs while increasing both quality and access for all patients using MTFs.

References

Anderson, R., Sweeney, D., & Williams, T. (1997). Quantitative Methods for Business (7th Ed.). South-Western Publishing Co.

Army Medical Command (MEDCOM), Program Analysis & Evaluation Manpower Requirements Branch (1999, 2001). Automated Staffing Assessment Model (ASAM II) Brief.

Army Medical Command (MEDCOM), Deputy Chief of Staff, Resource Management (1997). Automated Staffing Assessment Model (ASAM) Introduction.

Babbie, Earl. (1986). The Practice of Social Research (4th Ed.). California: Wadsworth Publishing Co.

Chapman, Suzann (1995). Sizing Up TRICARE Journal of the Air Force Association. August 1995, VOL. 78, No.8. Retrived from http://www.afa.org/magizine/Aug1995/0895tricare.asp.

Cooper, D. & Schindler, P. (2000). Business Research Methods (7th ed.). New York: McGraw-Hill.

Military Health Care Reclamation Group.(2003). "Keep Our Promise To America's Military Retirees Act"

Office of the Assistant Secretary of Defense for Health Affairs. (2001). U.S. Medicine Directory 2001, 36, 55-56.

Health Care Survey of DoD Beneficiaries (HCSDB), 1999: National Executive Summary Report (August 2000). Mathematic Policy Research. Washington, D.C.

Reiser, John. Headquarters, Army Medical Command (MEDCOM), Program Analysis & Evaluation Manpower Requirements Branch (1997). Automated Staffing Assessment Model (ASAM) Introduction.

Rust, G.S. (1990). Health Status of Migrant Farmworkers: A literature Review and Commentary. American Journal of Public Health, 80, 1213-1213

Rutledge, R. & Nascimento, P. (1996). Satisfaction with HMOs. Journal of Health Care Marketing, 16 (1), 22-27.

Sanders, D. (1995). Statistics: A first course (5th ed.). New York: McGraw-Hill.

Sculley, P. January 2001. Army Modernizes in Face of Shortfall. Retrieved February 27, 2001. http://www.usmedicine.com/article.

Sultz, H. & Young, K. (1999). Health Care USA: Understanding its organization and delivery (2nd ed.). Maryland: Aspen Publishers, Inc.ll.

TRICARE Web Site (2003). Retrieved October 30, 2003 from http://tricare.osd.mil.

TRICARE Stakeholder's Report: *Our Promise Kept, Our Nation Calls* (2002).

United States General Accounting Office (1995). Defense Health Care: Issues and Challenges Confronting Military Medicine (GAO/HEHS-95-104). Washington, D.C.

United States General Accounting Office (1998). Defense Health Care: Reimbursement Rates Appropriately Set; Other Problems Concern Physicians (GAO/HEHS-98-90). Washington, D.C.

United States General Accounting Office (1999). Appointment timeliness goals not met; Measurement tools need improvement (GAO/HEHS-99-168). Washington, D.C.

Department of Defense Appropriation Authorization Act for Fiscal Year 1975, Pub. L. No. 93-365, 5 U.S.C. §502, 88 Stat 399 (1974).

United States Army Regulation 570-4 (2000). Manpower Management.

United States Army Regulation 570-5 (1989). Manpower Staffing Standards System.

United States Department of Defense. February 29, 2000. Military Strength Figures for February 29 Summarized by the Department of Defense. Retrieved February 6, 2001.

United States Department of Defense Directive 1100.4. (1954). Guidance for Manpower Programs.

Woods, David (1999). The future of the Managed Care Industry and Its International Implications. Retrieved June 4, 2004 from http://workplace.samhsa.gov/wpResearch/meetingsnWorkshop/woods.pdf.

Appendix A

Joint Readiness Training Center (JRTC)

Rotation Units and Dates

Rotation #	Training Date	Brigade Combat Team	Medical Assets
JRTC 99-01	10-21 Oct 98	1/10th Mountain	Yes
JRTC 99-02	07-18 Nov 98	3/82nd Airborne	Yes
JRTC 99-03	14-21 Jan 99	2/1 Combat Division	No
JRTC 99-04	5-17 Feb 99	2/25th Infantry Division	No
JRTC 99-05	6-17 Mar 99	3/101st Air Assault	Yes
JRTC 99-06	10-21 Apr 99	Open	No
JRTC 99-07	13-24 May 99	2/10th Mountain	No
JRTC 99-08	12-23 Jun 99	29th Signal Battalion	Yes
JRTC 99-09	14-25 Aug 99	1/82nd Airborne	Yes
JRTC 99-10	11-22 Sep 99	101st Air Assault	Yes
JRTC 00-01	2-14 Oct 99	2/82nd Airborne	Yes
JRTC 00-02	6-17 Nov 99	49th Air Defense	No
JRTC 00-03	15-26 Jan 00	172nd Signal Battalion	Yes
JRTC 00-04	12-23 Feb 00	2/101st Air Assault	Yes
JRTC 00-05	11-22 Mar 00	Open	No
JRTC 00-06	4-15 Apr 00	3/82nd Airborne	Yes
JRTC 00-07	16-24 May 00	76th Signal Battalion	Yes
JRTC 00-08	10-21 Jun 00	Special Operations	No
JRTC 00-09	1-9 Aug 00	3rd ID/25th Infantry	No
JRTC 00-10	9-20 Sep 00	1/10th Mountain	Yes

Note. This table represents the JRTC rotation and dates for fiscal years 1999 and 2000. The third column from the left lists the combat unit that trained during the listed rotation. The fourth column from the left lists the availability of organic medical assets during the rotation.

Appendix B

Deseasonalized (Desez) Data for Fiscal Years 1999 and 2000 --- Baynes-Jones Emergency Room (BIA) Outpatient Visits (OPVs) --- Prediction of Fiscal Year 2001

			t						Y_t	$t*Y_t$
Fiscal Year	Month	Count of Month	BIA OPVs by Month	12 Month Moving Average	Centered Moving Average	Seasonal-Irregular Component	Adjusted Seasonal Index	Desez BIA OPVs	Month * Desez BIA OPVs	Month Squared (Sq)
1999	1	1	1,917				1.0879	1,762.16	1,762.16	1
	2	2	1,959				0.9601	2,040.42	4,080.84	4
	3	3	2,037				1.1017	1,848.90	5,546.71	9
	4	4	2,163				1.1569	1,869.68	7,478.74	16
	5	5	2,328				0.9934	2,343.53	11,717.65	25
	6	6	2,448				1.0417	2,350.09	14,100.57	36
				2,081.08						
	7	7	1,923		2,099.17	0.9161	0.9181	2,094.58	14,662.07	49
				2,117.25						
	8	8	2,182		2,122.58	1.0280	1.0302	2,117.95	16,943.57	64
				2,127.92						
	9	9	2,040		2,142.96	0.9520	0.9540	2,138.28	19,244.49	81
				2,158.00						
	10	10	1,835		2,172.88	0.8445	0.8464	2,168.13	21,681.28	100
				2,187.75						
	11	11	1,926		2,181.13	0.8830	0.8850	2,176.36	23,939.96	121
				2,174.50						
	12	12	2,215		2,166.33	1.0225	1.0247	2,161.60	25,939.21	144
				2,158.17						
2000	1	13	2,351		2,165.83	1.0855	1.0879	2,161.10	28,094.33	169
				2,173.50						
	2	14	2,087		2,178.50	0.9580	0.9601	2,173.74	30,432.37	196
				2,183.50						
	3	15	2,398		2,181.33	1.0993	1.1017	2,176.57	32,648.52	225
				2,179.17						
	4	16	2,520		2,183.04	1.1544	1.1569	2,178.27	34,852.36	256
				2,186.92						
	5	17	2,169		2,188.25	0.9912	0.9934	2,183.47	37,118.98	289
				2,189.58						
	6	18	2,252		2,166.67	1.0394	1.0417	2,161.93	38,914.80	324
				2,143.75						
	7	19	2,107				0.9181	2,295.00	43,604.97	361
	8	20	2,302				1.0302	2,234.42	44,688.48	400
	9	21	1,988				0.9540	2,083.77	43,759.21	441
	10	22	1,928				0.8464	2,278.01	50,116.25	484
	11	23	1,958				0.8850	2,212.52	50,887.96	529
	12	24	1,665				1.0247	1,624.86	38,996.65	576
SUMS		300						50,835.36	641,212.13	4,900
		Σt						ΣY_t	$\Sigma(t*Y_t)$	$\Sigma(t^2)$

t bar =	12.500
Y bar =	2,118.140
b_1 =	5.018
b_0 =	2,055.415
T_t =	2,055.421+5.018 t

Appendix C

**Linear Forecast for Fiscal Years 1999-2000 –
Bayne-Jones Emergency Medicine (BIA) Outpatient Visits (OPVs)**

Fiscal Year	Month	Deseasonalized (Desez) Error	Desez Error Squared	Linear Forecast	Linear Error	Linear Error Squared
1999	1	-155.84	23,976.18	2,060	143.43	20,573.03
	2	81.42	6,629.37	2,065	106.45	11,331.82
	3	-188.10	35,380.52	2,070	33.47	1,120.17
	4	-293.32	86,034.25	2,075	-87.51	7,658.53
	5	15.53	241.19	2,081	-247.50	61,253.78
	6	-97.91	9,585.46	2,086	-362.48	131,389.58
	7	171.58	29,440.01	2,091	167.54	28,069.99
	8	-64.05	4,102.86	2,096	-86.44	7,472.05
	9	98.28	9,658.35	2,101	60.58	3,669.57
	10	333.13	110,974.41	2,106	270.60	73,221.65
	11	250.36	62,680.23	2,111	184.61	34,081.96
	12	-53.40	2,851.47	2,116	-99.37	9,874.20
2000	1	-189.90	36,061.28	2,121	-230.35	53,061.58
	2	86.74	7,523.99	2,126	38.67	1,495.14
	3	-221.43	49,032.10	2,131	-267.32	71,457.31
	4	-341.73	116,777.56	2,136	-384.30	147,684.18
	5	14.47	209.37	2,141	-28.28	799.70
	6	-90.07	8,111.98	2,146	-106.26	11,291.40
	7	188.00	35,343.41	2,151	43.76	1,914.68
	8	-67.58	4,566.55	2,156	-146.23	21,381.75
	9	95.77	9,172.24	2,161	172.79	29,857.42
	10	350.01	122,508.09	2,166	237.81	56,554.07
	11	254.52	64,780.36	2,171	212.83	45,296.18
	12	-40.14	1,611.20	2,176	510.85	260,964.66
		137.36	**837,252.43**	**50,835**	**137.36**	**1,091,474.38**

Deseasonalized mean squared error	**36,402.28**	**Linear mean squared error**	**47,455.41**

Appendix D

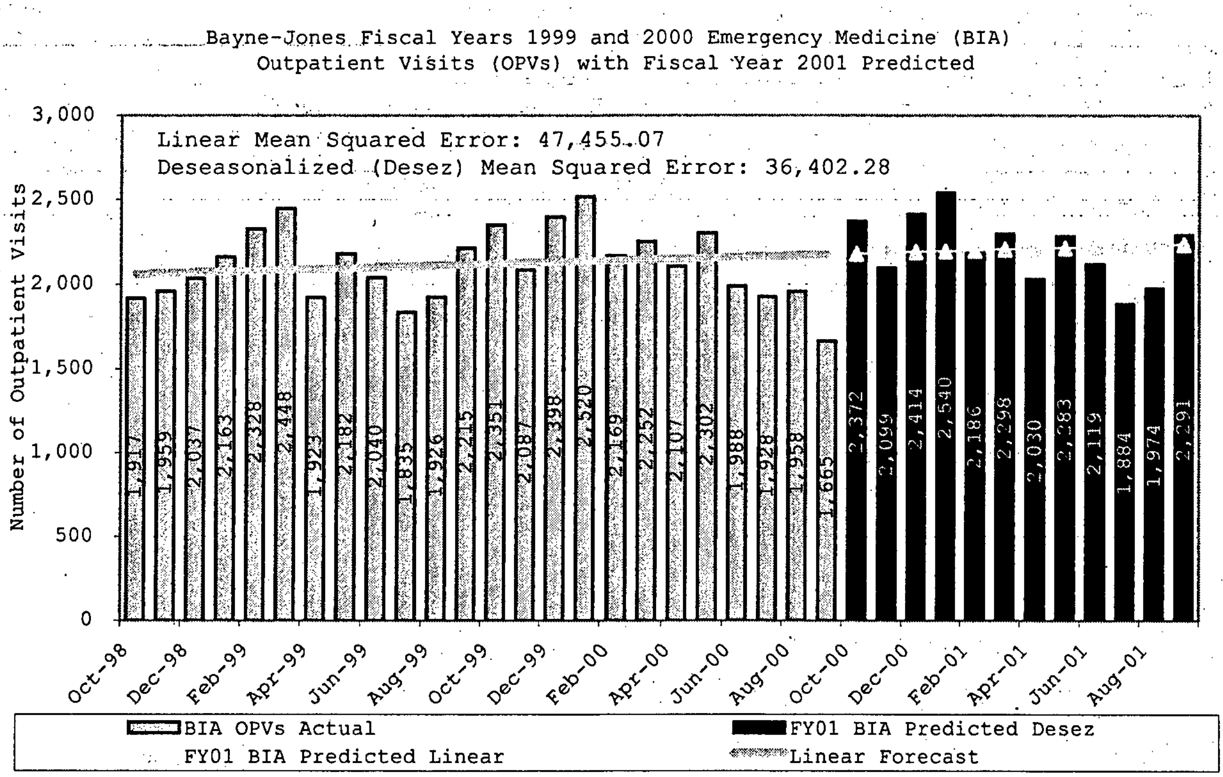
Predicted Fiscal Year 2001 Bayne-Jones Emergency Medicine (BIA) Outpatient Visits (OPVs)

Fiscal Year	Month	Count of Month	Trended Forecast of OPVs (Linear)	Seasonal Index	Monthly Deseasonalized Forecast
2001	1	25	2,181	1.0879	2,373
	2	26	2,186	0.9601	2,099
	3	27	2,191	1.1017	2,414
	4	28	2,196	1.1569	2,540
	5	29	2,201	0.9934	2,186
	6	30	2,206	1.0417	2,298
	7	31	2,211	0.9181	2,030
	8	32	2,216	1.0302	2,283
	9	33	2,221	0.9540	2,119
	10	34	2,226	0.8464	1,884
	11	35	2,231	0.8850	1,974
	12	36	2,236	1.0247	2,291

Seasonal Index Calculation

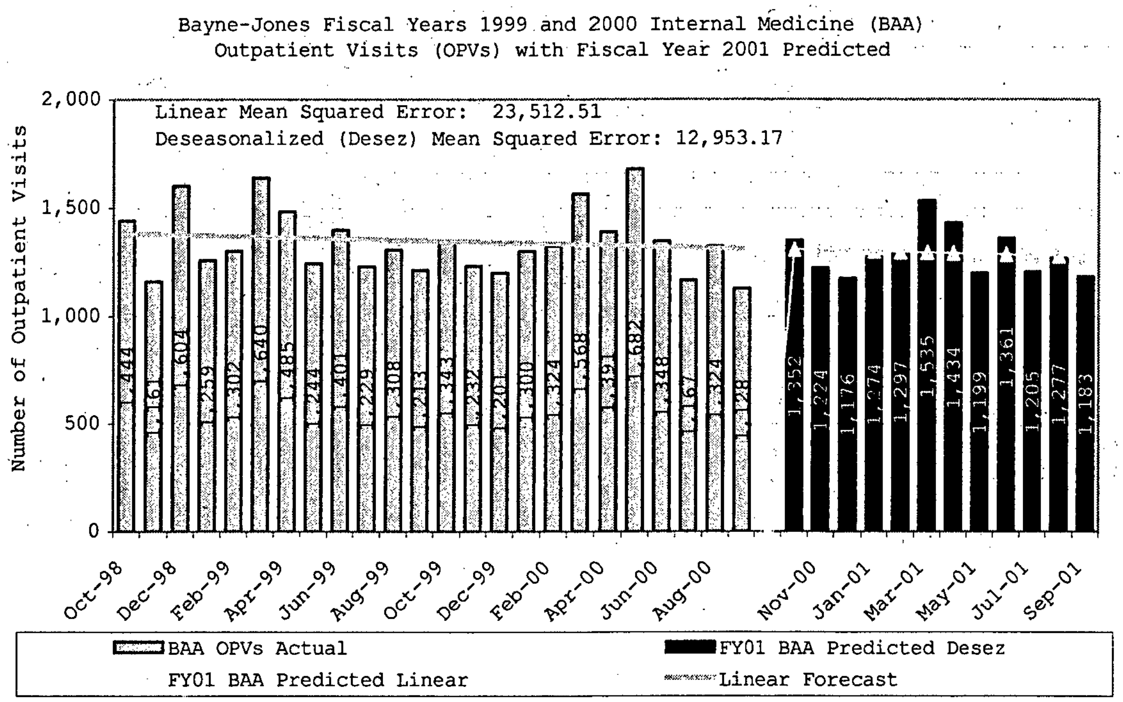
Month	Seasonal Index	Adjusted Seasonal Index
1	1.0855	1.0879
2	0.9580	0.9601
3	1.0993	1.1017
4	1.1544	1.1569
5	0.9912	0.9934
6	1.0394	1.0417
7	0.9161	0.9181
8	1.0280	1.0302
9	0.9520	0.9540
10	0.8445	0.8464
11	0.8830	0.8850
12	1.0225	1.0247
	11.9738	12.0000

Appendix E



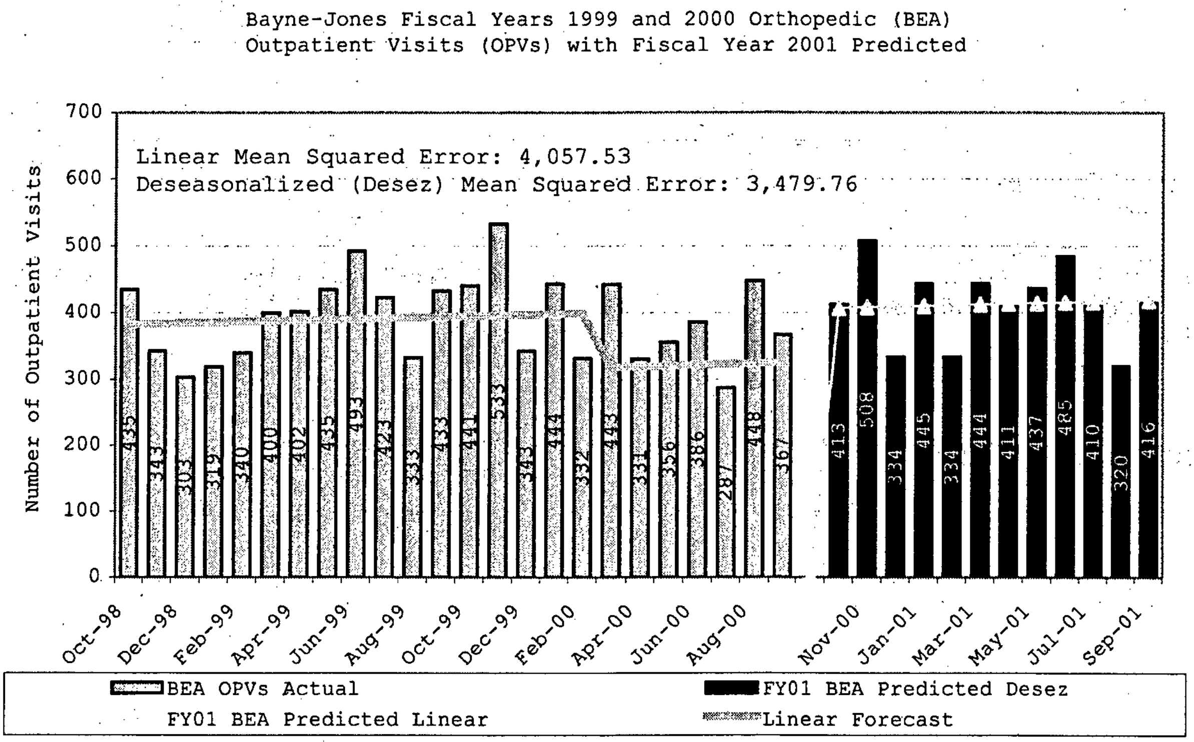
Note: The mean squared error is a way to determine the goodness of fit of the model. In this case, mean squared error for the deseasonalized model is smaller than that of the original model, showing that it is a more precise predictor of workload.

Appendix F



Note: The mean squared error is a way to determine the goodness of fit of the model. In this case, mean squared error for the deseasonalized model is smaller than that of the original model, showing that it is a more precise predictor of workload.

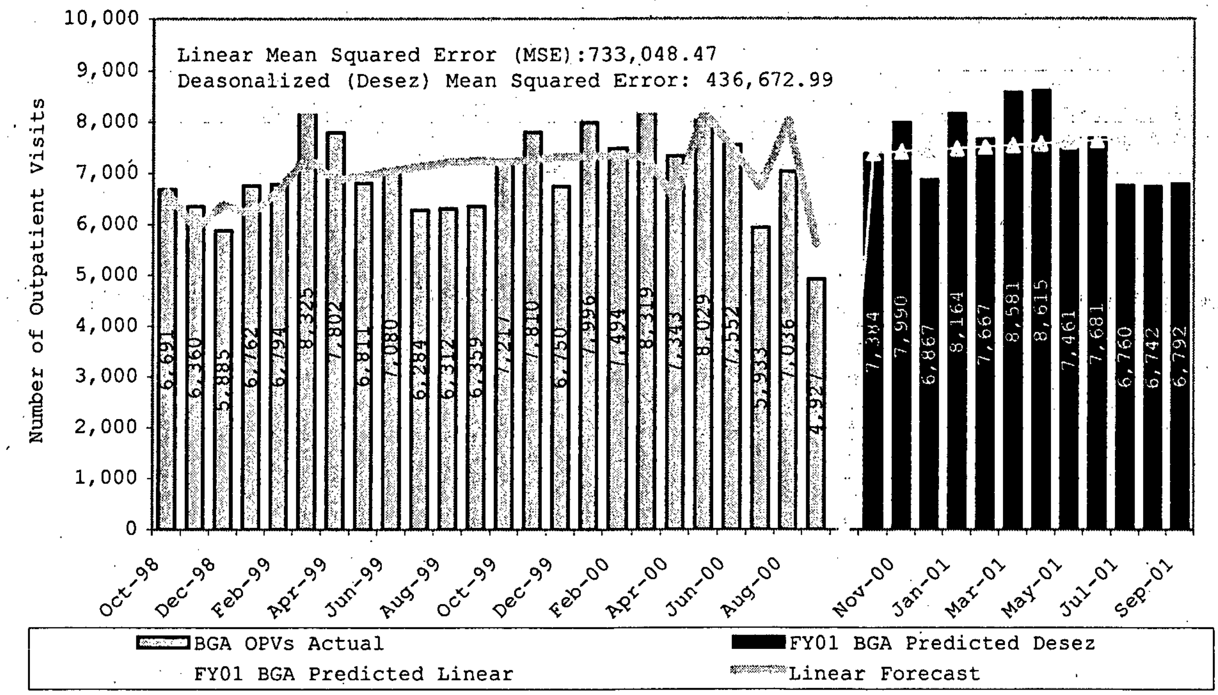
Appendix G



Note: The mean squared error is a way to determine the goodness of fit of the model. In this case, mean squared error for the deseasonalized model is smaller than that of the original model, showing that it is a more precise predictor of workload.

Appendix H

Bayne-Jones Fiscal Year 1999 and 2000 Family Practice (BGA)
Outpatient Visits (OPVs) with Fiscal Year 2001 Predicted



Note: The mean squared error is a way to determine the goodness of fit of the model. In this case, mean squared error for the deseasonalized model is smaller than that of the original model, showing that it is a more precise predictor of workload.

Appendix I

One-Way Analysis of Variance of Visits by Month

in the Four Clinics

	Sum of Squares	df	Mean Square	F
Between Groups	158,0599	5	-316,120	0.048
Within Groups	118,418,560.000	18	6,578,808.889	
Total	119,999,159.333	23		

Note: Values enclosed in parentheses represent mean square errors.